Gamestar Mechanic: Reflections on the Design & Research of a Game About Game Design.

Ivan Alex Games
Univeristy of Wisconsin-Madison
games@wisc.edu

Abstract:

This paper presents a design study on the research and development of Gamestar Mechanic, a game-based learning project where children learn 21st century language and literacy practices in the context of learning key principles of game design. Using a design research methodology for the overall project, and a case study methodology for individual testing and theory refinement iterations of the research, this paper presents a detailed account of the first two years of research and design of the game, in hopes of providing researchers, educators and instructional designers with some insights on the development and assessment of 21st century learning environments.

Introduction:

In 2006 former vice-president Al Gore released a movie documentary called "An Inconvenient Truth" (Guggenheim, 2006) in which he presented a substantial amount of scientific evidence regarding the contribution of humans to global warming. Aside from warning us about the potentially catastrophic consequences that our failure to address this issue could bring, it also made it evident that the solution will not be a simple one, as the relationship between man, technology and nature is on of multiple variables and not completely predictable one.

Global warming is but one example of the increasing number of highly complex challenges facing our nation and the world today, with issues such as the overexploitation of limited potable water supplies (Midkiff, 2007) or the massive deforestation of the amazon being ugly reminders of our failure to secure a future for ourselves and the planet. One consistent message coming from those warning us of these issues however is that in order to tackle them we will need new ways of thinking, a new mindset that can harness our curiosity and imagination today so that we can find solutions tomorrow.

In order for this new mindset to emerge however, several educational scholars have also recognized there is a need for a new type of literacy to be taught in schools, for literacy skills are the essential foundations upon which later learning is based. Some have argued that the widespread dissemination and lowering cost of information and communications technologies have made it possible for *new literacies* to emerge, characterized by thinking and meaning production practices more attuned to the needs of an increasingly global society (Lanskhear and Knobel, 2006; DiSessa, 2002).

Videogames have been recognized as some of the most sophisticated products of such new literacies, immersing players in situations where critical thinking, strategic problem solving and systems-level understanding are required (Gee, 2003). As a consequence, games have been increasingly adopted within formal and informal learning environments in a variety of ways that range from using commercial games to support instruction to

designing games specifically tailored to instructional goals (Games, Learning and Society, 2005).

This paper presents a design study of the first two years of a research project on the design and assessment of *Gamestar Mechanic*, an online multiplayer role-playing game designed to foster middle school children's 21st century language and literacy skills, by teaching key principles of game design (Games and Squire, 2008; Salen, 2007).

The Gamestar Mechanic project is a collaborative research and development effort between the Games, Learning and Society Group at the University of Wisconsin-Madison and Gamelab, a professional game design studio based in New York. The development of the game has been funded by the John D. and Catherine T. Macarthur Foundation's Digital Media Initiative, an effort to promote research that deepens our understanding of the ways in which digital technologies are impacting the social, civic and academic lives of today's youth.

The game is set within a narrative that places players in the role of *game mechanics* in a fantasy world where games provide the fundamental energy on which life is sustained. In the game narrative however, disaster has struck and the once working system upon which the world function has fallen to disrepair. As they advance towards restoring harmony to the world, players also move towards membership in an elite organization called the *Council of Master Mechanics,* some of which are represented by game characters but which can also be impersonated by live players. To do so, they must complete a series of *jobs* that involve playing, designing, documenting and repairing games, as well as discussing their games and having them rated and critiqued by others.

To complete these jobs, mechanics must collect a series of *sprites* (e.g. heroes and enemies), creatures pre-designed with specific qualities and behaviors. A mechanic's sprites are stored within his/her *toolbox* (see figure 1), a web-based game editor where sprites can be dragged from a palette into a play area, and combined into new games.

Figure 1: Completing a Job with the Gamestar Mechanic Toolbox.

A fundamental aspect that the game exploits in order to foster the appropriation of a game designer Discourse by learners is framing these jobs in the context of a robust

community of mechanics with a variety of levels of expertise in game design. In addition to the game narrative, the game supports the emergence of such a community through several in-game facilities (see Table 1) that together provide the framework upon which the Gamestar Mechanic experience rests.

Table 1: Gamestar Mechanic Discourse facilitation features.

Tool	Description
Workshop	This profile page provides players with an organizational framework to track the games and jobs that thy have completed or need to complete. It also provides others with a place to identify a specific mechanic's game design interests and preferences through a character profile, as well as his/her relative status in the community in the form of an experience level and the ratings for the games he/she has created.
Toolbox	In this toolbox the player can access the collection of sprites available to him/her so far, and use them to design new games. This toolbox also serves as the context within which factory jobs will be tackled whether their goal is to play, fix or design games from scratch.
Factory	The factory is the central metaphor for the fantasy world of Gamestar Mechanic. In it, players begin the game with most areas covered with steam and very few jobs available for them to work on. As they successfully complete jobs, the game then updates the state of the world, more jobs become available in the map, and new areas of the factory accessible, as the steam recedes from them.
Game Alley	The game alley provides the public arena where the true "value" of a game can be tested. Games that are published by designers in their toolbox become available to play by others in this area. When a published games is played, a rating scale and a form to provide comments are associated to it on the website.

Having been a core member of the Gamestar Mechanic team for the last two years has been a rewarding experience, and one of personal growth for me in many ways. Thus, in presenting this account of our research and design process, my aim is twofold: first, to contribute to the literature on games and learning by presenting researchers and practitioners with my insights and those of other team members regarding a novel way to approach literacy instruction in the classroom. Second, I hope that by sharing the lessons learned in this project I can provide instructional designers contemplating the development of videogames for learning with useful insights for their own designs.

Theoretical Framework:

Since its inception the design, implementation and assessment of Gamestar Mechanic have relied on the socio-cultural theoretical framework that informs much of the recent theories on games and learning (Gee, 2003; Steinkuehler, 2006; Squire, 2006; Shaffer, 2006). This theoretical perspective conceives knowledge as a function of the interactions

between individuals, the social groups they belong to, and the material context that surrounds them. This body of research includes a diversity of scholarly work commonly associated with social constructivist perspectives of learning (Vygotsky, 1978) including (but not limited to) activity theory (Emgestrom, Miettinen and Punamaki, 1999), situated learning (Lave, 1993; Lave and Wenger, 1991), mediated action (Werstch, 1991), connectionism (Bechtel and Abrahamsen, 1990), socially embodied cognition (Barsalou, Niendenthal, Barbey and Rupert, 2003), distributed cognition (Hutchins, 1995), ecological psychology (Gibson, 1977), Discourse theory (Gee, 1992; 1996; 2005), and sociocultural theories of literacy (New London Group, 1996).

As a design experiment, the game is engineered to be a reification of theory as much as a vehicle for its testing and refinement. As such, the goal for the Gamestar Mechanic team has been to produce a learning environment that encourage the appropriation of what Gee refers to as the big "D" Discourse of game designers (1996). By discourse, he refers to an "identity toolkit" represented by the ways of doing, communicating, thinking, and interacting with the material world that people use to demarcate an identity as members of a particular community to others (in this case, an identity as game designers).

It is important to mention that while Gamestar Mechanic is a game about game design, its purpose as a learning tool is not to train professional game designers. Rather, by immersing students in key activities of game design, it is intended to be an *epistemic game* (Shaffer, 2006) that encourages learners to think like game designers do. According to Gee (2007) "In epistemic games, learners do things that have meaning to them and to society. Such games are *knowledge games*. They are meant to teach learners both how to navigate complex linguistic, cognitive, and symbolic domains and to innovate".

While an increasing number of such communities are becoming available online in sites such as *kongregate ©, gamebrix©* and *sploder©*, a core difference with Gamestar Mechanic is that the community is framed in the context of a role-playing game. The purpose of this is to take advantage of the potential that games have in terms of encouraging players to "try on" virtual identities, in this case a game designer identity (Gee, 2003 P. 48).

Methods:

Aside from a game, Gamestar Mechanic is also an experiment in engineering a pedagogy centered on game design. As with similar experiments the main methodology that the Gamestar Mechanic team has followed throughout these years to document the learning that takes place in this context has been Design Research (Brown, cite; Collins, cite). Design research (also referred to as design experiments) is a methodology aimed at iteratively developing and refining theory regarding innovative educational interventions in authentic settings. At the same time, it aims to reify the refined theory in subsequent redesigns of the intervention itself, allowing researcher new opportunities to test it. Through these iterations of design-hypothesis testing-redesign, its objective then is to gradually develop an understanding of the overall ecology of the intervention, its components, and systemic relationships (Cobb, et al. 2003). Gamestar Mechanic is also a *teaching experiment* (Cobb, 2000) for the role of the researchers has been in many cases to manipulate the context to achieve the desired learning goals for the students. While skeptics might claim that such interventions "taint' the research context and diminish its

validity, we subscribe to Cobb's argument that effective instructional methods develop as a result of such goal-oriented manipulation, and better theories of instruction result.

Data Collection: An integral part of the design studies is keeping a systematic record of the observations done during the different research iterations, so as to be able to provide a detailed and credible account of the changes that took place between them. The data sources for this study were collected by members of Gamestar Mechanic research team during the two years of research, and included transcripts of interviews with players and members of the Gamestar Mechanic team, naturalistic and participant observations, field notes, audio and video recordings, as well as digital and paper-based documents.

Data Analysis: In this paper I provide an account of the design and research process for Gamestar Mechanic. Each cycle of the research involved sometimes the same, sometimes slightly different contexts and groups of participants as required for testing our evolving theoretical questions. For this reason I decided to treat each cycle as a separate case using case study methodology (Stake, 1995) to describe the components, goals, settings, outcomes and lessons learned from it. I present each case using an ethnographic methodology (Geertz, 1983) focused on presenting a "thick description" of the events, participants and material context involved.

The cases represent three cycles of research and implementation that have taken place over the life of the project. In their respective sections, I provide detailed descriptions of the relevant participants, context and data sources. I coded the data collected from the different sources according to the framework proposed by Collins, Joseph and Bielazyc (2004). In order to verify the trustworthiness of the constructs identified, I submitted the data for verification and joint analysis by other members of the Gamestar Mechanic team, in addition to relying on the multiple data sources generated in each phase to triangulate my interpretation of these constructs.

Limitations of the Study: One of the central limitations of using the design research approach is that it generates "humble" theories (Cobb, et al. 2003) that are specific to the particular design and context for the study. Such theories necessarily forfeit any claims to grand generalization. In this case, an aspect that could be perceived as a possible limitation to this research is the fact that while the objective of the game is to promote the thinking practices of game designers on young learners, the fact that the game has been designed by Gamelab necessarily implies that the practices promoted will be those of *some* game designers. While this is certainly an issue if one wants to make an argument for large-scale generalizability, the Gamestar Mechanic team members see it also as strength. Given the wide variety of approaches and styles that different designers bring into their own design process, it can be confusing and difficult for new learners to come to understand the nuance and complexity of their Discourse. The structure provided teaching a specific approach to design can provide a scaffold for these learners a point of reference from which they can think critically about other approaches they learn in the future. Nevertheless I caution against extrapolating too far on these observations.

One final limitation of the study is that some of the student samples used for the research have been convenience samples. Given the

Fieldwork: The Design and Assessment of Gamestar Mechanic

In this section I present an account of the first two years of design and research of Gamestar Mechanic. I organize the narrative according to the two stages of design and

implementation that have concluded at the time of writing. Being a product of design research, Gamestar Mechanic is not only meant to inform learning theory development, but also to be a reification of such theory at different stages of its evolution. For consistency with the language used in the data and description, I found it useful to label the three cycles according to the widespread (some would even say standard) nomenclature used to identify different stages of the software release lifecycle (Software Release Lifecycle, 2008): pre-alpha, and alpha. These labels refer to the degree in which the features of a software product have been successfully implemented and tested within it, with pre-alpha representing a basic prototype and alpha typically representing a product where most core features are implemented, but where those core features may still undergo changes.

Cycle 1 - The Pre-Alpha Phase:

Research into the learning potential of the game formally began during the Fall of 2006, a time during which the Madison and New York members of the Gamestar Mechanic team conducted extensive reviews of the literature and software associated with existing interventions involving game design for learning (Hayes and Games, 2008), with the purpose of informing the initial design strategy for Gamestar Mechanic. Advised by the researchers in Wisconsin, the Gamelab designers engaged an intense process of research and creative production involving initial versions of the look and feel for the game interface, the narrative and the play experience, all of which were documented digitally in a design document and a shared wiki site. The outcome of this process was that by November of that year, an initial prototype of the game was available for testing. Two instances of prototype testing took place in Madison between the late Fall semester of 2006 and the early Spring of 2007, described in the following sections:

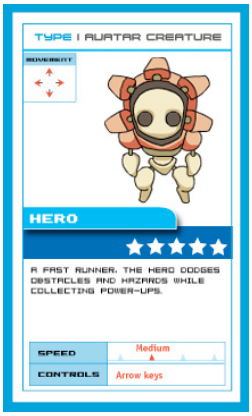
Elements and Goals of the Prototype: The prototype consisted of a) an early version of the *toolbox* with a limited set of sprites and fixed behaviors, b) paper based *sprite profiles* that would allow the players to compare sprite descriptions and make decisions as to which to use in their games, c) a rudimentary version of the *game design curriculum* within the narrative and jobs in the form of paper-based narrative storyboards, and d) a *game label* format where players would write the description and instructions for their games. Table 2 shows an example of each of these components. Their purpose was to simulate as completely as possible the overall experience of playing Gamestar Mechanic. Because the game in meant to be a reification of learning theory, this prototype would allow us to conduct initial empirical tests of some key theoretical questions.

Test 1 Settings and Documentation Methods: The first test of the prototype took place in two over two days in December 2006 at a computer lab in the University of Wisconsin-Madison. We recruited the participants from the general community through flyers announcing a mini game design workshop for children. The participants were sixteen children ranging in age from 6th to 8th grade from diverse ethnic backgrounds including African-American, Hispanic, Asian American, and Caucasian, and there were slightly more males than females. Before beginning the workshop, we conducted a series of informal interviews with them on their gaming preferences and history, we found that all had played games before, and at least half considered themselves "gamers." Only two

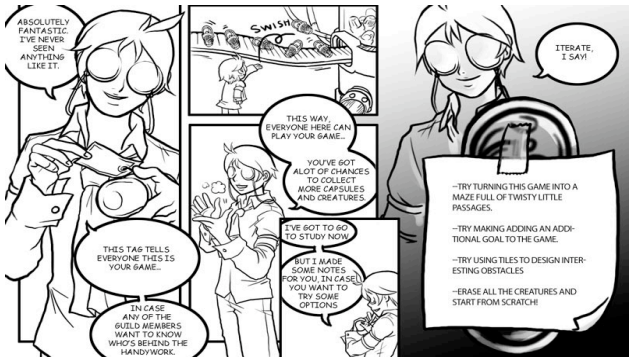
responded that they had made a game before, and in both cases they said these were board games made as part of a school assignment.
At this point in the research one of our core questions was whether the game would be interesting and engaging to them. Current games and learning theory tells us that well designed games promote extended engagement by the players, and that this engagement is a crucial component in promoting player adoption of the identities proposed in them (Gee, 2003) As a consequence, a goal of simulating the overall Gamestar Mechanic experience was for us to assess whether the core learning activities within it would foster such engagement, for otherwise we would have to rethink our approach to design altogether. We also had questions regarding the steepness of the learning curve that children would experience trying to play the game, especially given that some of the prototype's functions had not been thoroughly tested yet.

Table 2: Components of the Gamestar Mechanic Prototype.

a) Toolbox



b) Sprite Profile



c) Narrative Storyboard

d) Game Label Form

We tested for these questions in two ways. First, we wanted to test the participants'

responses to the individual aspects of the design curriculum within the game. Pairs of children played the game mediated by a designer in a small room with a one-way mirror. The designer followed a protocol that simulated the prompts and dialogues that the narrative and characters in the complete version of the game would present to players. This protocol asked players to tackle both structured and open-ended design jobs, the first ones requiring the player to directly designing games on two computers. During the session, the designer to simulate the kind of in-game prompts and dialogues that will be present in the final version of the game, and the kids worked both with structured challenges and in open play where they could design games from scratch. These sessions were video recorded, and members of the Gamestar Mechanic team observed and collected field notes from behind the one-way mirror.

Second, we were interested in their responses in the context of the community-based activities of the game, sharing, rating and making games for others. To test this, I gave children a quick presentation introducing the narrative of the game, and a demo on using the toolbox to make a simple game. We then asked children to go play in a computer lab with ten computers, where I gave them the rules for a job that required making games for others to play test, and fix them using any feedback obtained from their peers.

In order to garner some initial insights regarding their engagement with the game, we also gave them access to a video game lab where they could play many popular games such as Guitar Hero and Halo.

Test 1 Outcomes: While our observations on this initial test were preliminary and too early to reach any conclusions, they were encouraging as well. Even after hours of playing with the game and having the option always open to go play other games (which they took on several occasions), most of them kept coming back and trying new designs with the toolbox prototype during the 6 hours that the session lasted. It was also encouraging to see the speed at which the children were able to pick up the editor and begin designing. It was also noticeable that the social jobs were effective ways to engage the players with design, the boys tended to enjoy first designing complete games to share with friends more rapidly than girls. The designs themselves however would commonly use a shooting the enemy mechanic and tended to be more simplistic. Girls in contrast tended to design in groups, with one girl controlling the mouse while others commented and made suggestions to her. The designs took longer to make, but were more complex in their use of space and used a variety of mechanics such as collecting coins or navigating a maze.

This test also initially hinted at the ways in which students might initially conceive terms from the specialist language of games. As they designed or tested games, I would walk around the room and ask them if they thought the game they were making or playing was good. Several of them responded in function of the difficulty, with statements such as “this game is too easy” or “this game is cool cause it’s super difficult!” typifying their responses. One final interesting observation was that about half the students preferred designing games on their own, while the other half preferred to do it socially hinting at the possibility that we would have to implement multiple paths to advance in the game to keep players engaged.

Test 1 lessons learned: This test however, also hinted at some limitations of the game model we had not expected. Even though the editor was designed with the intention of letting children test out individual creatures and iteratively improve their games, we

noticed that the majority of them would take at least 15 minutes designing a game before testing it even the first time, leaving questions open as to what degree of understanding of individual components of their games they could get from the game. One of the ways that the initial prototype aimed to encourage this was by letting players modify (mod) previously designed games, however most of the time students seemed to prefer erasing all the creatures on the screen and starting new games of their own from scratch.

In this initial prototype, the game design jobs consisted of games that could be played in a single screen of the game. During the test however, several of the players asked whether they could create games with multiple levels, a function not implemented in the toolkit at that point. This limitation however, became an opportunity for us to observe the way in which players could work around the limitations of the game to make their design intentions happen, as instead of creating a single game with multiple levels, they created multiple games representing different levels of difficulty of the same concept using the name of the game, and presented them to their peers this way.

One question that remained unanswered at this point was the degree to which children would appropriate the specialist language of game designers, a crucial component in enacting their Discourse. From the observations done in this initial test there was very little to suggest that the children were using the language presented in the storyboards or the creature profiles to discuss their designs, and it remained an area of interest for further testing.

Test 2 Setting and Documentation Methods: As a result of our preliminary observations during the first test, the Gamestar Mechanic team made the decision to follow-up with a more in-depth set of tests. Even though the preliminary observations suggested that children found the game engaging, the question still remained regarding whether they would sustain engagement with it over an extended period. We also wanted to know whether such engagement would lead to students appropriating more of the practices of the Discourse of game design, and whether the curriculum designed for the game would facilitate this appropriation.

Observations from our previous test suggested that the game jobs (both social and indvidual) would provide the most promising contexts to answer these questions, since most participants' design took place in this context. In order to structure the workshop around jobs, I used a set of job templates provided by Gamelab with the prototype storyboards. These templates were short texts that described the instructions and scope of the specific job the children needed to complete. Jobs were organized according to three categories: a) *play jobs* –where players needed to win a game previously designed, b) *repair jobs* –where they had to identify and fix a problem with a dysfunctional game-, and c) *design jobs* – where they had to design a game from scratch within constraints specific to the Discourse. A design label for example would typically look like the following:

"A core mechanic represents the essential moment-to-moment activity of the player, what the players will do over and over as they play. For this challenge, make a game where the core mechanic is to *collect things*. When you're done, write the instructions for your game so that others can play it."

We conducted a second round of tests in Madison, during the Spring of 2007, using an extended workshop format where a group of participants would meet 2 hours a week for 8 weeks. The workshop was structured around the jobs, and during each session the

participants would attempt to tackle one to three of them depending on their scope. To focus the test on collecting more in-depth participant data as opposed to group level data, only five middle school between the 7th and 9th grade from the Madison, Wisconsin area were selected for participation. Three of the children were girls and two were boys (who I henceforth will refer to with the pseudonyms Ana, Barbara, Carla, David and Edgar), for but only the two boys and one girl identified themselves as regular gamers.

Even with this self-assessment, the amount of experience and play time for the boys was nearly twice that of the girls in terms of hours/week invested in play. Moreover, one of the boys (with the pseudonym David) explained that aside from playing games he watched the G4 channel (a cable channel dedicated to videogames) for several hours a week, which was substantially more experience than any other participant.

Barbara had a visual impairment that required her to do her work very slowly, but otherwise did not stop her from participating. The girls knew each other and the boys knew each other, but there were no cross gender acquaintances. The children came from a various socioeconomic backgrounds, and all of them were Caucasian. Attendance to the sessions was voluntary, and during the whole workshop the children had the option of leaving the computer room and going to the game room to play with the game consoles.

During this stage of the research also aimed determine the most effective ways to document the learning process of players. Given our interest in collecting in-depth data on their enactment of the game designer Discourse, we chose methods that would capture as fully as possible the interactions between the participants, the toolbox and the job context. One of the main tools people can recruit in order to participate in a Discourse is its set of language practices (Gee, 1996; 1999; 2005). Through language, participants situate meanings and construct reality for each other and ultimately demarcate an identity as members of a community. In this context, what it means to "know something" is a function of the interaction between two or more participants; since one can only claim to know something if someone else is there to validate it (Gee 2005, p. 23).

With this in mind I attempted to capture the language practices of participants using both oral and written samples. I relied on structured and semi-structured interviews *Video recording* became very useful for capturing the oral practices, as I conducted recordings of the participants' verbal exchanges during the workshops, as well as of interview data that I conducted with individual participants at various points as well. For the written data I relied on the *game label* format provided by Gamelab in the prototype (See Table 1-d). Because the articulations we were most interested in were those about their games or those of others, I decided to use *Camtasia Studio ©*, a screencasting tool that generated a digital video of they play or design process in the computer screen, to provide a context for the analysis of their language.

Together, the video data, text data and screencast data provided a powerful and flexible framework that could be adapted to either the social or individual level. In the interest of assessing participant progress, at some points in the workshop I decided to use this framework in the context of an individual interactive interview, a method I designed where the participant would explain out loud their design process as they tried to tackle a job in the toolkit. During the interview, the researcher asks open-ended questions aimed at prompting the students to elaborate on their meaning-making process (Games and Squire, 2008). These assessment points, together with the workshop video data and the

records of the games they made (stored permanently in a remote server) provided a complete developmental profile on the Discourse practices of each child.

Test 2 Outcomes: The observations in this second set of tests served to both confirm and disconfirm some of our initial assessments. Both the boys and the girls kept attending through all the sessions and completed most of the jobs successfully. As before, the social jobs were the ones that seemed to generate most enthusiasm among the children. For the girls, this was characterized by intense spans of collaborative design and discussion. This provided an opportunity for Barbara to participate by making suggestions to the other girls as they designed. With the boys, these jobs were marked by a mood of competition with comments such as "check my game out, I bet you can't win it!" typifying their exchanges during these jobs. The cycles of design in this case were different however, possibly due to David's gaming experience. For the girls, the design cycles still lasted about 15 minutes before the first test took place, but for the boys this time was more inconsistent and while in some sessions they would do the same as the girls, in design tasks with more open ended constraints the boys might complete a simple shooter game in under 5 minutes and give it to the other boy to play.

This approach to their design became really insightful however. During a social job involving designing a game using a few creatures and giving it to someone else to play, both of the boys finished their games very quickly. They traded games and David was able to win Edgar's game very easily, which led him to point out those aspects that Edgar could change in his game to make it more challenging. Cycles of testing and feedback such as these showed much potential for the students' learning.

An advantage of this test format over the previous one was that having the children present over an extended period of time allowed me to see some of the changes in their sophistication with the Discourse of game designers. One of the questions that I used during the interviews to assess this issue was to ask the participants to tell what they thought a game designer did, and simplistic responses such as "have fun an produce fun games" would be typical. By the end of the workshop, more sophisticated responses such as "a game designer plays games, he learns about other games, and he designs games" were more common among participants, reflecting the activities that they would participate in with Gamestar Mechainc. However, these observations also suggested that the speed with which a player would increase in sophistication with their designs would have as a factor the previous gaming experience of the player, for David began discussing his and other's games at this level of sophistication much earlier in the workshop than the rest, a notion that echoes findings reported by several studies in the learning sciences (Chi, 1985; Glaser, 1984).

The individual interactive interviews provided several insights as well, particularly regarding the role of the participant's previous gaming experience in appropriating the practices of the game designer discourse. During these interviews, the task I gave participants was to design any game they wanted with only four sprites from the palette. Even though all of the players who participated in the interview mid-way into the workshop made more sophisticated games than they did at the beginning, as I have reported in detail elsewhere (Games and Squire, 2008) David's interview suggests that the sophistication of his games was superior to those of the others because his extensive gamer background allowed him to more easily grasp the common aspects of the *design grammar* (Gee, 2003) of the game by comparing it to other games he had played.

Test 2 Lessons Learned: One of the concerns about the game that arose from this test was regarding the players' writing. A good game designer must recruit effective writing skills to communicate as much as any other knowledge profession. In several of the Gamestar Mechanic jobs, writing was required either to inform others about their game (using the game label) or to critique and feedback to others for improvement. Most of the writing done by the children however, tended to be succinct and sine qua non, even when it was evident from their verbal articulations and discussions that they had much more sophisticated ideas about their games. Its possible that this was due to the fact that up to this point the game simulation had not tied the jobs in the game to the overall narrative, and thus writing was not seen as something valuable by the players. More importantly, this rose a concern because it brought to our attention that even though the language in the jobs integrated some of the specialist language of game design, the students were not appropriating it for their own use in the labels. This was concerning especially for those children who lack the specialist language of school (Gee, 2004), and for whom Gamestar Mechanic was supposed to be an entry into a specialist language. This suggested that a future iteration of the game should integrate the writing components more closely into the game if it was to promote 21st century literacy practices on children.

Numerous comments by the children during the workshops also rose the concern that the look and feel of the game was too limited, and that even when we were trying to simulate the overall experience of the game, its full learning potential would only come as a result of integrating all of the components in the model, including a more aesthetic look and feel.

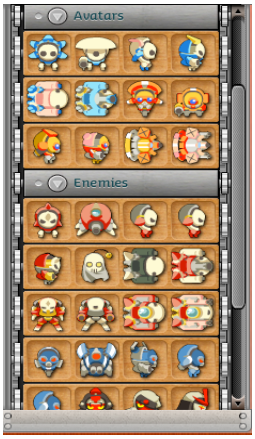
Cycle 2: The Alpha Phase

Throughout the whole process of testing the prototype build of Gamestar Mechanic, the research and assessment group in Wisconsin remained in continuous communication with the designers, both through weekly phone conferences, meetings, email discussions and a shared wiki site that served as a repository for a digital design document of the game. In this way, as the assessment was ongoing in Madison, so was the feedback we provided Gamelab with being incorporated into the next implementation of the game: the alpha build.

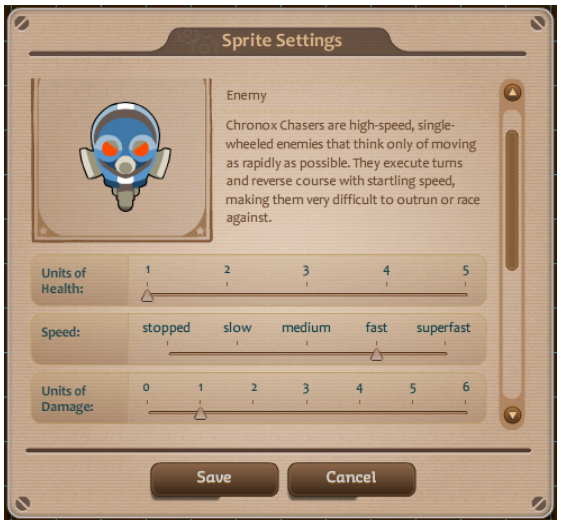
Elements and Goals of the Alpha Build: The new implementation of the game was released to the Madison team in March of 2007. It consisted of a toolbox with many improvements. These were a) an improved look and feel, b) an extended sprite set with c) customizable behaviors and digital profiles d) the ability to create multilevel games and customize level properties, and e) digital game labels. As Table 2 shows the game was beginning to take more on the shape of what a commercial game would look like. At this point however, we still needed to do more research regarding the curriculum before Gamelab would integrate it in digital form, and for this build we relied on the paper-based job templates. This had an advantage however, for by leaving the job definitions in paper, it was possible for us to try different combinations, and in fact even create jobs that would place students in the position of having to rely on forms of knowledge valued in academia, making Gamestar Mechanic behave like a *flexibly adaptative learning environment* (Schwartz, et. al, 1999). Taking advantage of this, our goal for the alpha build tests became to test a curricular implementation of the game in a variety of learning environments both formal and informal, as making it as widely available to children as possible was a goal for the game since its inception. So far the workshops we had

Table 2: Components of the Gamestar Mechanic Alpha build.

a) New toolbox look and feel.

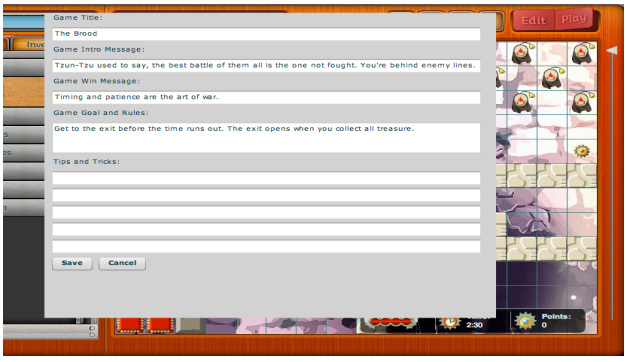


b) extended sprite pallete



c) sprite profile and behaviors

d) level properties



e) a game label

conducted had taken place in the form of informal after-school activities, but in the Summer of 2007 we had an opportunity to test the game in a more formal setting at a summer technology academy in the Milwawkee, Wisconsin area. The following sections describe this test.

Test Setting and Research Methods: The test for the alpha build took place at a highschool in a suburb of Milwawkee, Wisconsin in the Summer of 2007, as part of a summer technology academy. The academy took place over three days of instruction, 5 hours a day for a total of 15 hours at the library of one of the town's high-schools. We designed a version of the curriculum implementing critical learning experiences from the game and simulating Gamestar Mechanic's community and design jobs. We also designed a pre and post assessment protocol for this curriculum in order to identify changes in students' specialist language and literacy practices, their understanding of game design, and systems-level thinking. Two members of the Gamestar Mechanic research team conducted the test, alternating in instruction and documentation roles throughout the test. 15 middle school male students participated in the academy, 10 of which were included in the assessments.

The general structure of the assessments consisted of four general sections:

a) Concepts about Game Design Interview: A set of questions about games and game design as an activity. It included questions such as "What do you think a game designer does?" aimed at getting students to elaborate on their conceptions of what the goals of a game are and what kinds of activities comprise game design as an enterprise.
b) Paper-based game design task: We gave the participants a variety of materials including colored pens, paper, dice, chips and tokens. We asked them to try to design a new game using these materials within a time frame of 15 minutes, including its rules and a description for players.
c) Gamestar Mechanic toolbox design task. We gave participants an open-ended game design task within the Gamestar Mechanic toolbox, where they had to design a game around the idea of "save the lakes". We also gave them a brief instructional tour of the toolbox features, and throughout the design process conducted an interactive design interview to assess their meaning making practices during the process.
d) Concepts about Systems Interview: The last part of the pre-post assessment session consisted on a questionnaire aimed at assessing participants' notions of games and systems. The questions in this section included "What is a system?" "Could a game be considered a system? Why?" and "What other systems besides games do you experience in daily life?"
a) The workshop itself was structured into eight modules meant to highlight key ideas within game design such as space, components and core mechanics (Salen and Zimmerman, 2003) that were designed to form the pedagogical core of the Gamestar Mechanic experience. Each module began with a mini-lecture introducing the module's game idea meant to familiarize the students with the language used in the game. After each

lecture participants were given combinations of 3 the three types of jobs, playing, fixing and designing games.

Test 1 Outcomes: During the post-assessment, it became evident that some students began to recruit a variety of specialist language terms to articulate their explanations of game designs. The overall game designs they produced became gradually more refined throughout the workshop, and by post-assessment they took into consideration more aspects of the game as system, such as considering the affordances of different game materials for specific aspects of design.

In general, getting individual participants to produce written content was not an easy task, however they tended to produce a lot more in the context of the collaborative exercises, an encouraging observation in light of the concerns about writing we had in previous tests.

Individual participants tended to specialize on specific game designs, preferring to perfect those designs than start completely new ones. Some of the participants were able to develop more sophisticated views of the game design activity, as well as of the systemic relationships between its sub activities. This was also reflected on their responses to questions about systems.

The structure of the curriculum we designed lent itself very well to a summer academy format, partially due to the fact that some students were enrolled in the school where it took place, and partially because there was an expectation on the part of the kids that this would be an extension of their school activities. This however, left open the question of whether this curriculum format would also work on more unstructured environments such the ones in our initial tests.

During the collaborative jobs, the students relied as much on demonstrations of actual game play on the computer screen as they did on verbal explanations. In some of these cases, the verbal explanation, even using the specialist terms of game design, would have proven insufficient to communicate the designer's point.

Simulating the game dynamics by providing a reward system functioned quite well to motivate these students. However, one must also take into account the fact that many of their teachers were present in one form or another in the premises of the workshop, and so in some ways the feeling of the overall activity was more school-like than informal.

Test 1 Lessons Learned: Even though in this workshop we saw more writing than in the two previous ones, in general the writing samples we could collect from students tended to be very succinct and not very high quality. This might have been in part due to the fact that trying to simulate on paper the online conversations that players would actually have in Gamestar Mechanic's blog, resulted in a somewhat clumsy communication mechanic. Nevertheless the question remained open regarding the best way to integrate writing into the game. During this test, we also experienced some unexpected technical difficulties that raised a lot of concern. Every time 10 or more students logged into the game simultaneously, the server at Gamelab would crash and log everyone out until it was restarted. While it was not a showstopper issue, it definitely led us to realize how essential a reliable server connection will be for the dissemination of the game. Consistently with previous tests the students expressed themselves very well of the game

and seemed quite enthusiastic to go back to their designs. In particular, the more social the jobs were, the more effective they seemed to be in promoting student engagement with the game, as well as reflection on their designs. It became clear that unless the community aspect of the game was fully functional, the full learning potential of Gamestar Mechanic would not be realized.

Conclusion

As I reflect on the last two years playing, designing and researching Gamestar Mechanic, I begin to realize what a long way we have come since the humble prototype we had in 2006. As I write these lines, the third year of the project is ongoing, a new version of the game has been released and a new cycle of testing is taking place. So far, the findings from the cycles reported here have been really encouraging, especially when one considers that the game is still not in its final release form and we have already seen some emerging evidence that players may indeed be appropriating some of the specialist practices of game designers. At the same time, these findings have suggested to us a diverse number of directions where future iterations could go, since questions such as how to best integrate writing into the game, or what the best way to structure its community components remain largely unanswered. Even with these preliminary versions of the curriculum however, the game is already showing promise not only for teaching language and literacy, but because of the flexibility it gave us as instructor in designing new jobs, it could potentially be used to teach other concepts such as systems thinking, or some principles of software design. This shows one of the advantages of the design experiments methodology, and of flexibly adaptable designs, since many potential branches of research could emerge with different variations of the game.

At the same time, these workshops have also shown us some of the limitations that traditional methods of assessment might have in the context of innovative learning interventions such as Gamestar Mechanic, where meaningful expression comes not only in verbal form, but in visual and experiential form as well. With the interactive design interview format, we took the first step into identifying better and more effective ways to assess the understandings of children in these contexts, an area of research that will play a key role in determining the effectiveness of 21st century curricula.

As we move forward with the game, it also becomes clear that designing and deploying complex learning interventions such as Gamestar Mechanic will require that we first put into practice ourselves the new mindset we are trying to instill in our young learners ourselves, so as to produce interventions that take into consideration the deep complexities of the classroom and learning environments of the 21st century.

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